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Modelling a set of carbon-rich AGB stars at high-angular resolution

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Abstract

We compared spectro-photometric and interferometric observations of six carbon-rich AGB stars with a grid of self-consistent model atmospheres. The targets are: R Lep, R Vol, Y Pav, AQ Sgr, U Hya and X TrA. Please refer to the publication Rau et al. (subm) for further details on those findings.

We used VLTI/MIDI interferometric observations at high-angular resolution, and spectro-photometric data. We compared the observations with self-consistent dynamic models atmospheres from the Upssala group (Eriksson *et al.*, 2014; Mattsson *et al.*, 2010). We found partly similar results as in Rau *et al.* (2015). The models can reproduce SED data well at wavelengths longward of 1 μm, and the interferometric observations between 8 μm and 10 μm. Shortwards of 1 μm in the SED, and longwards of 10 μm in the visibilities, we note discrepancies which could be due to a combination of effects: data- and model-related.

The models which fit the best the Miras are significantly extended, with a significant shell-like structure. On the contrary, the models best fitting the non-Miras are more compact, showing lower average mass-loss rate.

We derived stellar parameters from the fits: T_{eff}, L_{models}, M, C/O, $\dot{M}$. The results are in good agreement with values from the literature, within the uncertainties. T_{eff} agrees with the temperature derived from the angular diameter $\theta_{(V-K)}$ and the bolometric luminosity from the SED fitting, L_{bol}, except for AQ Sgr. We discuss in the text the likely reasons.

Finally, the Rosseland diameter θ_{Ross} and $\theta_{(V-K)}$ (van Belle *et al.*, 2013) agree with each other better for the Miras targets than for the non-Miras, and we speculate that the reason for that resides in the episodic mass loss of the latter models.

We placed the stars in the H-R diagram (see Fig. 1), confronting them with evolutionary tracks. The main derived properties (L, T_{eff}, C/O ratios and stellar masses) from the model fitting results in good agreement with TP-AGB evolutionary calculations for carbon stars (Marigo *et al.*, 2013).

Acknowledgments

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References

Eriksson, K., Nowotny, W., Höfner, S., Aringer, B., & Wachter, A. 2014, A&A, 566, A95.
Marigo, P., Bressan, A., Nanni, A., Girardi, L., & Pumo, M. L. 2013, MNRAS, 434, 488.
Mattsson, L., Wahlin, R., & Höfner, S. 2010, A&A, 509, A14.
Rau, G., Paladini, C., Hron, J., Aringer, B., Groenewegen, M. A. T., *et al.* 2015, A&A, 583, A106.
van Belle, G. T., Paladini, C., Aringer, B., Hron, J., & Ciardi, D. 2013, ApJ, 775, 45.

[1]Available at http://www.jmmc.fr/aspro

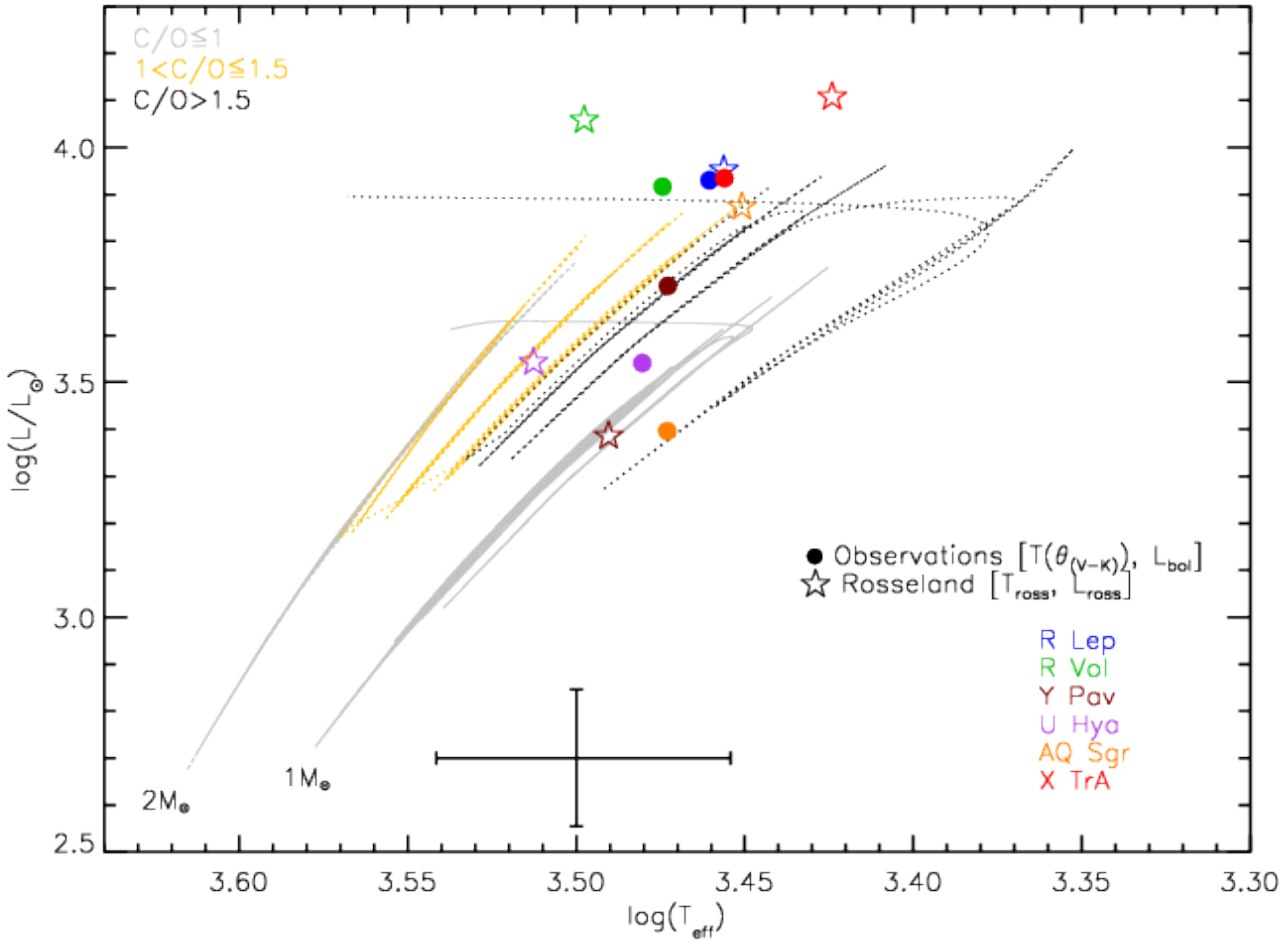

Figure 1: AGB region of the H-R diagram (see also Rau et al., subm). The lines show evolutionary tracks with solar metallicity from Marigo *et al.* (2013). The numbers denote the mass values at the beginning of the thermal pulsing (TP)-AGB. In a dotted line, for better visibility, is displayed the track with 2 $M_{\odot}$. Different symbols refer to temperatures and luminosities estimated via observations and through finding models best fitting with spectro-photometric-interferometric-observations. Several colors indicate the different targets. A typical error bar is shown in black in the lower left of the figure.